UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/829,161	04/09/2001	Salman Akram	.3442.1US (96-428.1)	8260

24247 7590 03/21/2003

TRASK BRITT
P.O. BOX 2550
SALT LAKE CITY, UT 84110

EXAMINER
NGUYEN, HA T

ART UNIT	PAPER NUMBER
2812	

DATE MAILED: 03/21/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/829,161	AKRAM, SALMAN	
	Examiner	Art Unit	
	Ha T. Nguyen	2812	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 January 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-26 and 72-106* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-26 and 72-106* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 14 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Notice to applicant

1. Applicant's Amendment and Response to the Office Action mailed 10-08-02 has been entered and made of record (Paper No. 15).

Response to Amendment

2. In view of Applicant' s amendment to the Specification and to the claims, the objection to the Specification and to claims 1-26 and 72-102 have been withdrawn.

In view of Applicant' s arguments and amendment to the claims the rejection of claims 72-75, 78-90, 92-102 as being unpatentable over Brenna et al. (U.S. Patent 6074943, hereinafter "Brenna"), has been withdrawn.

Applicants' arguments with regard to the rejections under 35 U.S.C. 103, as being unpatentable over Liu et al. (US Patent 6277745, hereinafter "Liu") Brown (U. S. Patent 6030896) or Brenna (for the remaining claims) have been fully considered, but they are not deemed to be persuasive for at least the following reasons.

Applicant argued that Brown does not disclose a second dielectric layer in contact with the single conducting layer, in Fig. 3, when 18 is considered to be the single conducting layer then the oxide layer substituting the layer 20 (see col. 4, lines 50-62) is equivalent to the claimed second dielectric layer and it is in contact with the single conducting layer 18.

Applicant also argued that Brown fails to teach "said metal containing spacer extending to substantially the same height as said single conducting layer" and the second dielectric layer in direct contact with the single conducting layer, the examiner disagrees, Fig. 3 shows the spacer 22 extending to substantially the same height as the single conducting layer 16 and that the second dielectric layer 25 in direct contact with the single conducting layer. Therefore Brown does make obvious the limitations of the claims 1-11, 14-26, 72-89, and 92-106.

Applicant argued that the barrier layer 8 in Liu function as a barrier metal layer not a conducting metal , the examiner disagrees, TaN, TiN are conducting materials containing metal and Ta is a metal (see col. 3, lines 37-49), even though it functions as a diffusion barrier for the diffusion of Cu, it is still a conductor by nature. The claims do not preclude the conducting metal from performing the function of diffusion barrier .

Applicant argued that Liu fails to teach the metal containing spacer extending to substantially the same height as said single conducting layer and the single conducting metal in direct contact with the second dielectric layer. The examiner disagrees Fig. 2B shows the single conducting metal 8 is in direct contact with the second dielectric layer 16 and Fig. 2D shows the spacer 14 extending substantially the same height as the conducting layer 8. Depending on the amount of etching the spacer the size of the spacer varies, with longer etching time the spacer would extend substantially the same height as the conducting layer 8.

Applicant also argued that Liu fails to teach the second dielectric layer having sidewalls aligned with sidewalls of the conducting layer and the spacer extending to substantially same height as said single conducting layer. The examiner disagrees, Fig. 2B clearly shows the sidewalls of the second dielectric layer 16 and the conducting layer 8 are aligned. Fig. 2D shows the metal spacer 14 extending along the sidewalls of the second dielectric layer. Therefore Liu does make obvious the limitations of claims 1, 11-13, 72-75, 88-91.

Applicant argued that Brenna does not form the multiplayer structure by removing aligned portions of the second dielectric layer , single conducting layer, and at least one metal containing barrier layer. The examiner disagrees, Figs. 2C, 2D and col. 2, lines 42-50 show that the multiplayer structure is formed by etching said layers. Besides applicant argued based on his own interpretation of the features in Brenna not based on the examiner's matching up of features in Brenna considered to be equivalent to the features claimed, for example the examiner considered PETEOS layer 220 to be equivalent to the claimed second dielectric and conductor 215 to the claimed conducting layer while applicant argued on dielectric layer 250 and sidewalls 260. With the examiner's interpretation, the second dielectric layer is in contact with the single conducting layer. Therefore, Brenna does make obvious the limitations of claims 1-12 and 14-24.

The claimed methods of deposition are well known in the art, using a conventional method to perform a conventional function is within the skill of a person of ordinary skill in the art.

Applicant is referred to a new ground of rejection below.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371© of this title before the invention thereof by the applicant for patent.

4. Claims 72 and 79 are rejected under 35 U.S.C. 102(e) as being anticipated by Joo (U. S. Patent 5879957).

Referring to Figs. 8A-8F and related text, Joo discloses a method for making a metallization structure for a semiconductor device, comprising: providing a substrate 54 having a dielectric layer 42 underlying at least one metal containing barrier layer 53 of TaN (see col. 6, lines 4-6); creating a single conducting layer 45 over the at least one metal containing barrier layer; removing aligned portions of the single conducting layer, and at least one metal containing barrier layer to form a multilayer structure (see Fig. 8E); and flanking at least one surface of the multilayer structure with a metal containing spacer 49, said metal containing spacer 49 extending to substantially the same height as said single conducting layer (see Fig. 8F).

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 83 and 84 are rejected under 35 U.S.C. 103(a) as being unpatentable over Joo.

Joo discloses substantially the limitations of claims , as shown above 83 and 84.

But it does not disclose expressly the single conducting layer comprises at least one of Al and Cu or an Al-Cu.

However, the examiner takes official notice that it is well known in the art to use Al, Cu, or Al-Cu as conductor material.

A person of ordinary skill in the art is motivated to use Al, Cu, or Al-Cu instead of Ru to have low resistance material.

Therefore, it would have been obvious to use Joo' s teaching to obtain the invention as specified in claims 83 and 84.

7. Claims 1-11, 14-26, 72-89, and 92-106 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brown (U. S. Patent 6030896).

[Claims 1 and 72-74] Referring to Figs. 1-5 and related text, Brown discloses a method of fabricating a semiconductor device, comprising the steps of: forming a substantially planar first dielectric layer 10 on a substrate (see col. 4, lines 11-13); forming at least one metal containing barrier layer 12 over the first dielectric layer; forming a single conducting layer 18 over the at least one metal containing barrier layer; forming a second dielectric layer in contact with the single conducting layer (see col. 4, lines 50-62); removing aligned portions of the second dielectric layer, single conducting layer, and at least one metal containing barrier layer to form a multilayer structure (see Fig. 2); and forming metal containing spacers 22 on sidewalls of the multilayer structure, said metal containing spacers being substantially the same height as said multilayer structure (see Fig. 3), for claim 72, the corresponding single conducting layer is 16 and the spacer 22 extending to substantially the same height as said single conducting layer. But it does not disclose expressly that the spacer is of a metal containing material. However, the missing limitation is well known in the art because Brown also discloses that Ta, Ti, TaN, and TiN are equivalently used diffusion barrier material (See col. 4, lines 15-19) .

[Claims 2 and 78] wherein said forming the first dielectric layer comprises forming a silicon oxide or BPSG layer (see col. 4, lines 11-14);

[Claims 3, 5, 79, and 80] wherein said forming the at least one metal containing layer comprises forming the at least one metal layer of Ti, Ta, W, Co or Mo or an alloy or a compound of any thereof, including TaN or TiN and wherein said forming the at least one metal containing layer comprises forming the at least one metal layer of titanium or titanium nitride (see col. 4, lines 15-18);

[Claims 4 and 81] comprising forming a metal containing barrier layer 12, said metal containing layer comprising TiN, TiW, WN, or TaN (see col. 4, lines 13-19), the examiner takes official notice that it is well known in the art that Ti and TaN are conventionally used in combination with TiN and TaN, respectively, to increase adhesion, in this case a second metal containing barrier layer is between a first metal containing barrier layer of said at least one metal containing barrier layer and the substrate

[Claims 6 and 82] wherein said forming the at least one metal containing barrier layer comprises forming the at least one metal containing barrier layer of titanium or titanium nitride (see col. 4, lines 13-19];

[Claims 7 and 83] in the case where the etch stop layer 16 is of SiN, a conventional etch stop layer, single conducting layer 14 comprises forming the conducting layer from at least one of aluminum and copper (see col. 4, lines 32-49] and the second dielectric layer would be SiN 16;

[Claims 8 and 84] Brown does not teach wherein said forming the single conducting layer comprises forming the conducting layer of an aluminum-copper alloy. However the examiner takes Official Notice that aluminum-copper is a conventional conducting material used in semiconductor device when lower cost and ease of fabrication are desirable.

[Claims 9, 10, 85 and 86] wherein said forming the metal containing spacers comprises forming at least one layer of Ti, Ta, W, Co or Mo, or alloys thereof or compounds thereof, including TaN and TiN ; wherein said forming the metal containing spacers comprises forming the metal containing spacers of titanium or titanium nitride (see col. 4, line 11-col. 5, line 5);

[Claims 11 and 89] wherein said forming a second dielectric layer comprises forming the second dielectric layer on the single conducting layer to have sidewalls aligned with sidewalls of the conducting layer, and forming the metal containing spacers to extend along the sidewalls of the second dielectric layer (see Fig. 2 and col. 4, lines 50-62);

[Claims 14 and 92] further comprising forming the at least one metal containing barrier layer and the metal containing spacers of a same metal, in the case where the layer 12 is formed of TiN or TiN (see col. 4, lines 15-18 and 63-67);

[Claims 15-18, and 93-96] Brown discloses substantially the limitations of claims 15-18, and 93-96, as shown above. But Brown does not discloses the method of deposition the at

least one metal containing barrier layer and the single conducting layer. However, it would have been obvious for a person of ordinary skill in the art to use CVD to deposit the layers to have the same method of deposition as the metal containing spacer layers to obtain conformal layers and to reduce the equipment requirements (see par. bridging cols. 4 and 5);

[Claims 19, 20, 97, and 98] wherein said forming the metal containing spacers comprises forming the metal containing spacers by CVD, vapor deposition and directional etching (see par. bridging cols. 4 and 5);

[Claims 21 and 99] wherein removing aligned portions of the second dielectric layer, single conducting layer, and at least one metal containing barrier layer to form a multilayer structure is effected by patterning and etching the second dielectric layer, single conducting layer, and at least one metal containing barrier layer (see col. 4, lines 50-62);

[Claims 22-24, 88, 100-103, and 105] wherein said forming the metal containing spacers comprises forming the metal containing spacer layer over the multilayer structure and first dielectric layer and removing portions thereof overlying the first and second dielectric layers; wherein said forming the metal containing spacers comprises forming the metal containing spacer layer over the multilayer structure and first dielectric layer by conformal deposition process; wherein portions of the metal containing spacer layer over the multilayer structure and first dielectric layer are removed by etching (See par. bridging cols. 4 and 5);

[Claims 75 and 87]wherein flanking at least one surface of the multilayer structure with a metal spacer comprises forming a metal containing spacer 22 layer on said second dielectric layer or on sidewalls of said multilayer structure (see Figs. 3, 5 and par. bridging cols. 4 and 5);

[Claims 25, 26, 76, 77, 104, and 106 further comprising removing any remaining portion of the second dielectric layer and upper portions of the metal spacers laterally adjacent thereto (see Fig. 5); by etching (see col. 5, lines 18-33).

Therefore, it would have been obvious to use Brown's teaching to obtain the invention as specified in claims 1-11, 14-26, 72-89, and 92-106.

8. Claims 1, 11-13, 72-75, and 88-91 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu et al., U. S. Patent 6277745 (Hereinafter Liu).

[Claims 1 and 72-75] Referring to Figs. 2A-2F and related text, Liu discloses a method for making a metallization structure for a semiconductor device, comprising: forming a substantially planar first dielectric layer 2 (see col. 3, lines 31-35); forming at least one metal containing barrier layer 4 over the first dielectric layer; forming a single conducting layer 8 over the at least one metal containing barrier layer; forming a second dielectric layer 16 over the single conducting layer; removing aligned portions of the second dielectric layer, single conducting layer, and at least one metal containing barrier layer to form a multilayer structure (see Fig. 2B); and forming metal containing spacers on sidewalls of the multilayer structure, said metal spacers being substantially the same height as said multilayer structure (see Fig. 2D); wherein flanking at least one surface of the multilayer structure with a metal spacer comprises forming a metal containing spacer 12 layer on said second dielectric layer (see Fig. 2C and col. 4, lines 20-67). The height of the spacer depends on the duration of the etching, when the etching is longer the spacer would be extending to substantially the same height as the conducting layer. But it does not disclose expressly that the first dielectric layer is formed on a substrate. However, the examiner takes Official Notice that it is well known in the art that a dielectric layer is formed on a substrate.

[Claims 11 and 89] Liu also discloses wherein said forming a second dielectric layer comprises forming the second dielectric layer on the single conducting layer to have sidewalls aligned with sidewalls of the conducting layer (see Fig. 2B), and forming the metal spacers to extend along the sidewalls of the second dielectric layer (see Fig. 2D); and

[Claims 12 and 90]; further comprising forming the second dielectric layer of a low dielectric constant material (see col. 5, lines 1-5).

[Claims 13 and 91] Liu discloses substantially the limitations of claims 13 and 91, as shown above. But it does not disclose expressly that the second dielectric layer is of fluorine-doped silicon oxide. However, the examiner takes Official Notice that it is well known in the art that polyimide and fluorine-doped silicon oxide are low k alternatives used in the fabrication of a semiconductive device .

Therefore, it would have been obvious to use Liu' s teaching to obtain the invention as specified in claims 1, 11-13, 72-75, and 88-91.

9. Claims 1-12 and 14-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brenna et al. (U.S. Patent 6074943, hereinafter "Brenna") .

[Claims 1-3, 5-11, 14, and 19-24] Referring to 2A-2H and related text, Brenna discloses a method for making a metallization structure for a semiconductor device, comprising: forming a first dielectric layer 200 of silicon oxide; forming at least one metal containing barrier layer 205 of TiN, over the first dielectric layer (see col. 2, lines 37-42); forming a single conducting layer 215 over the at least one metal containing layer; forming a second dielectric layer 220 over the single conducting layer; removing aligned portions of the second dielectric layer, single conducting layer, and at least one metal containing barrier layer to form a multilayer structure (see Fig. 2D); and forming metal containing spacers 240 of TiN on sidewalls of the multilayer structure, said metal spacers being substantially the same height as said multilayer structure (see Fig. 2F and col. 3, lines 28-34, col. 4, lines 32-58). But it does not disclose expressly that the first dielectric layer is formed on a substrate and it is substantially planar dielectric. However, the examiner takes Official Notice that in a semiconductor device it is well known in the art that a dielectric layer is formed on a semiconductor substrate.

[Claim 4] the barrier layer 205 is a metal containing barrier layer of TiN, the examiner takes official notice that it is well known in the art that Ti is conventionally used in combination with TiN, to increase adhesion, in this case a second metal containing barrier layer is between a first metal containing barrier layer of said at least one metal containing barrier layer and the substrate;

[Claim 12] Forming second dielectric layer of low dielectric constant (see col. 6, lines 33-39).

[Claims 15-18] Brenna discloses substantially the limitations of claims 15-18, as shown above. But Brown does not discloses the method of deposition the at least one metal containing barrier layer and the single conducting layer. However, it would have been obvious for a person of ordinary skill in the art to use CVD to deposit the layers to have the same method of deposition as the metal containing spacer layers to obtain conformal layers and to reduce the equipment requirements (see par. bridging col. 2, lines 51-58).

Therefore, it would have been obvious to combine with to obtain the invention as specified in claims 1-12 and 14-24.

Conclusion

10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for response to this final action is set to expire THREE MONTHS from the date of this action. In the event a first response is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event will the statutory period for response expire later than SIX MONTHS from the date of this final action.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ha Nguyen whose telephone number is (703)308-2706 . The examiner can normally be reached on Monday-Friday from 8:30AM to 6:00PM, except the first Friday of each bi-week.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Niebling, can be reached on (703) 308-3325. The fax phone number for this Group is (703) 308-7722.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.

Ha Nguyen
Primary Examiner
03 - 18 - 03